

TEXT TASKS – PREREQUISITE FOR DEVELOPMENT OF CREATIVE THINKING IN STUDENTS FROM GRADES 1-4

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Abstract:

Introduction: Creative work with text tasks helps to improve the educational process in mathematics for Grades 1-4, to create opportunities for developing education, to provoke the cognitive activity of the students and to develop their thinking.

Object: The object of this research work is to study certain tendencies for creative work with text tasks and to develop their respective methodology options for work in the education of mathematics for Grades 1-4.

This research work presents some theoretical concepts related to: text tasks; the stages for their solving, some of the tendencies for creative work with them; and the problem-productive strategy for education in mathematics in the primary school.

Methods: The experimental work includes qualitative and quantitative research of the problems specified in the above paragraph. The following methods were applied: didactical experiment, observation, test, content analysis, mathematical-statistical method for data processing.

Results: As a result of the experimental work it was found out that the percentage of the students from Grade 4 who failed to solve the text tasks with direct and indirect use of relations decreased from 31.2 % to 8.5 %. The percentage of the students who failed to describe situations from their surrounding environment using a mathematical model decreased from 45.3 % to 10.1 %. The percentage of the students who correctly composed text tasks increased from 29.5% to 71.6%. The difference in the results was proven to be statistically significant.

Conclusion: The applied methodology system of work with text tasks helped to develop knowledge, skills and competencies from a competency cluster “Numbers” and “Modelling”, and to develop creative thinking in the students from Grades 1-4.

UDC Classification: 37.01, **DOI:** 10.12955/cbup.v7.1433

Keywords: text tasks, productive strategies, education in mathematics

Introduction

The work with text tasks is the main promoter of the creative process in education of mathematics for Grades 1-4. Students who solve problem text tasks perform a heuristic activity and discover new knowledge and approaches.

According to D. Poya “thinking can be called creative if it creates means for solving future tasks. Larger the number and broader the variety of tasks to which the created means are applicable to, the higher the creative level of thinking is” (Poya, 1970, p. 274). The researcher determined 4 stages for solving text tasks: studying the content of the text tasks; making a plan to solve it; implementing the plan; and finally looking backwards.

Regarding the process of task solving the following need to be taken into consideration: “the consequent stages of task solving and of intellectual actions/operations for each particular stage, the types of reasoning and explanation of the task and finally, the process of summarizing and differentiation during task solving” (Menchinska, 1955, p.119). According to An. Manova “this process is a complicated analytic-synthetic process which is realized through the interaction between the task solving subject and the objective content of the task. This interaction is done gradually, on stages” (Manova, 1989, p.33).

In order to clarify the mathematical nature of the text tasks it is important that during the analysis students learn to see the different verbal expressions, the quantitative relations and the actual dimensions with their values in different situations. The way in which the particular task is solved is not important – through composing equations or through numeric expression. Students need to abstract themselves in order to clarify the mathematical nature of the task. Often in the education of mathematics for Grades 1-4 the analysis of the task is constrained merely to the content of the task, to separate the given and the wanted objects, to establish the relations between them, to make a plan for solving the task but not always include clarification of the mathematical nature of the task.

Object, subject and aim of the study

The aim of this research work is to study some of the directions for creative work with text tasks and to develop their correspondent methodology options for work during the education in mathematics for Grades 1-4.

The object of the research is the process of education in mathematics for Grades 1-4.

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The subject of the study is the contribution of the applied combination of productive and reproductive strategies, their respective approaches and methods of work for the development of knowledge, skills and competencies from the competency cluster “Modelling” in the education of mathematics for Grades 1-4 as part of the newly developed methodology system of work.

In order to achieve the aim of the research work the authors completed the following tasks:

- Research and theoretical analysis of: foreign and Bulgarian authors related to text tasks and creative work with them; concepts regarding strategies (reproductive and problem-productive), pedagogy technologies and productive methods.
- Study of the main characteristics of the problem-productive strategy and its application for the development of technologies and a methodology system of work, including their application in the education of mathematics aiming to facilitate the creation of conditions for creative work with text tasks in the education of mathematics for Grades 1-4.
- Study the efficiency of the applied problem-productive strategy in the methodology system of work during the educational process in mathematics for Grades 1-4. Comparative analysis and assessment of the results of the empiric study, and a summary. Then formulating conclusions.

The following criteria were introduced for the purposes of the empiric study: knowledge and skill to solve composite text tasks with direct and indirect use of relations, to write down the solution of the task in different ways and to use different ways to solve the task; knowledge and skill to describe situations from the surrounding environment using a mathematical model; knowledge and skill to collect data from different sources and to transform that knowledge into text tasks.

Some of the directions for creative work with text tasks are presented below. One of these directions is to create conditions for the students to compose the text of a text task as per the given question. This is difficult as there is significant indeterminacy caused by the fact discovered by J. Piaget that for the students from Grades 1-4 in their mental activity it is easier to go ahead from preconditions to effect while it is more difficult to go the other way round.

The question in the task determines only partially its storyline and this contributes for the indeterminacy in student's work. Thus, a problem situation is created. Students are required to demonstrate more imagination for the purposes of determining the storyline of the task. As preparation for this type of work for solving completed text tasks the teacher shall require the students to pay attention to the interrelation between the question and the conditions of the task. This process shall start in Grade 1. After solving a particular task, the children shall be required to also ask other questions to the condition of the task in order to create other tasks. It is recommendable to start this type of work with text tasks at the end of Grade 2.

For example, the students can be required to compose text tasks based on the following questions: How many boxes of candies have been produced? In this case, the composition of the text is restricted by the question. In order to enforce the creative element in children's activity, on the next stage more questions can be asked which will create opportunities for more flexible interpretations.

Another direction for creative work is when students have to solve a task in different ways. Using other words when students solve a task in a certain way, causes them to start searching other ways for its solution. Different ways of solving a task means solutions with different number of calculations or arithmetic operations done in a different order. The different characteristics of arithmetic operations are most often used as a mathematical basis for different ways of task solving. It is the teacher's decision which of the following methods to use: heuristic discussion, modelling, variational exercise, solving tasks per analogy, or the sample-error method.

For example, the task: In a vegetable garden they planted 8 rows of beans. Each row had 20 nests and each nest had 4 pieces of bean. How many pieces of bean have been planted?

It is recommended the teacher to prepare a number of similar tasks which they can use in different occasions during the educational process.

Composing a text task by the students is the most complicated creative productive activity. It is related to solving a problem task and for its successful completion the teacher needs to do successive transitions through all the stages of solution of a problem situation as part of their methodology work.

The following specifics of this work can be identified: combination of various activities like the selection and putting in certain relation of different values, modelling, coding, verbal description of real situations containing qualitative and quantitative relations.

The composition of text tasks as a productive activity of the students shall be realized in a systematic manner during the education of mathematics for Grades 1-4. Composing text tasks can start only after the moment when the students have solved a sufficient number of already made text tasks. There must be a gradual increase of complexity of this activity.

Initially, the teacher must start in front work with the whole class. It will help if they do dramatizations, demonstrations or use a dashboard with movable elements in order to improvise certain situations in front of the students.

Using analogy in respect of the structure of the task, the teacher can work with the students requiring them to compose a task similar to the one that has just been solved by them.

The work continues with composing a text task according to an object-analytic picture. For example, in the education of mathematics in Grade 1 the below picture can be used (Bogdanova, Temnikova, 2016, p.94).

Figure 1: Composing text tasks according to an object-analytic picture

Source: Bogdanova and Temnikova, 2016

Further during the work more complex object-analytic pictures can be used and gradually the collective work shall give way to the individual composition of tasks by the students.

From composing text tasks as per object-analytic pictures, students can proceed to composing text task as per the given picture. Thus, a higher level of difficulty is introduced and a problem situation is created because the different images hide different aspects which can be comprised by different tasks involving the objects in the picture. It is necessary the teacher to use the experience which the students gathered during the process of composing tasks as per the object-analytic picture. In the next stage of the work there must be gradual transition towards composing test tasks as per two and later as per more numbers, as per given arithmetic operation, and later as per two and more arithmetic operations, and at the end – as per given numbers and later more arithmetic operations.

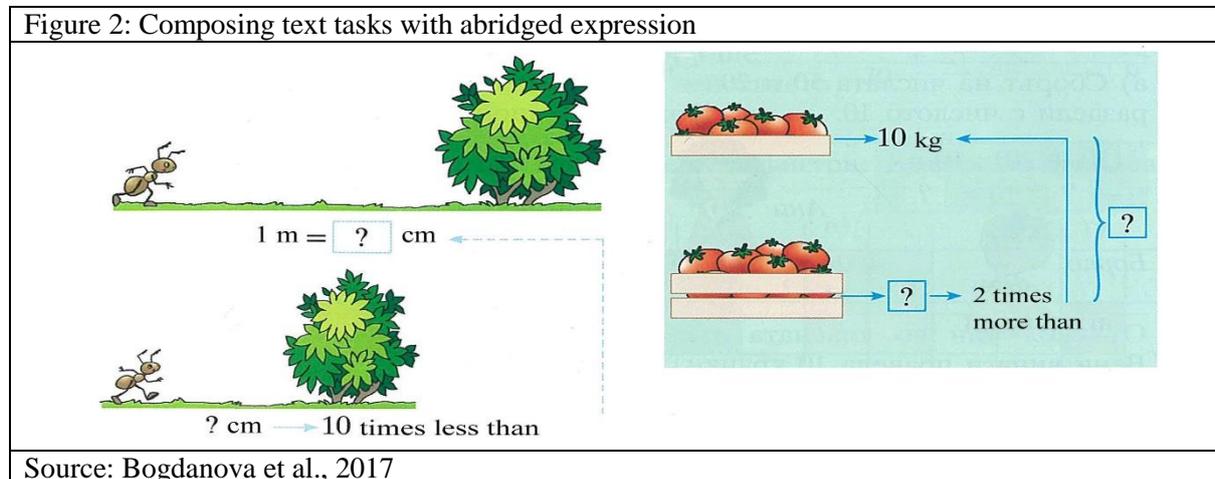
Composing text tasks with an abridged expression must start in Grade 2 with the application of a problem-productive strategy of education. In this case, there are pre-given parameters, their values and the relations between them. The students must select and clarify the content of the task and then compose a verbal model of a real-life situation specified by them (Bogdanova et al., 2017, p.80). An example is given in Figure 2.

From this abridged expression it becomes clear that the task in sub-clause a) shall be related to the distance passed by the ants after knowing the distance passed by one of the ants and how many times this distance is shorter than the distance passed by the second ant.

In b) the task shall be related to kilograms of tomatoes knowing how many kilos contain one of the crates and how many times more kilos contain the other crate.

For the two sub-clauses the following questions need to be clarified: Do we need to calculate only the distance passed by the second ant or the distance passed by both ants and do we need to calculate the

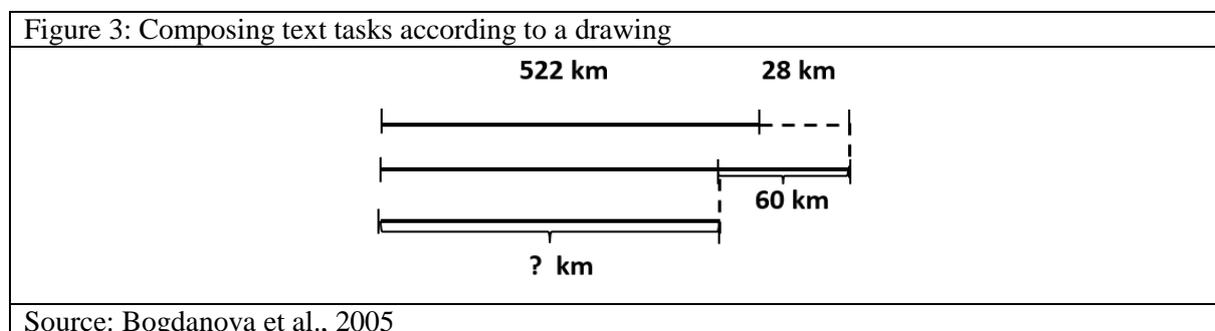
kilos of tomatoes in the second crate or the whole quantity of tomatoes in both crates. For solving these two problem tasks it is important how the teacher will structure the questions for the discussion, in what logical sequence in order to help the children. The proposals given by the students, the mistakes they make as well as the ways to correct them are very important. Initially, the teacher can help the students offering only the question or only the sentence through which the particular component of the task is expressed. Gradually this help is stopped or is offered only to the children who have difficulties in mathematics in general.



The next stage which is related to higher abstractness and more complicated mathematical and creative activity represents the composition text tasks as per a given diagram. In this problem situation students work on composing a task as per a given drawing (facilitating-schematic model). This is one of the most difficult problem tasks that can be assigned to the students (Bogdanova et. all, 2005, p.47).

For example:

Compose and solve a task using below data:



Further during the work more complex object-analytic pictures can be used and introduced gradually to the collective.

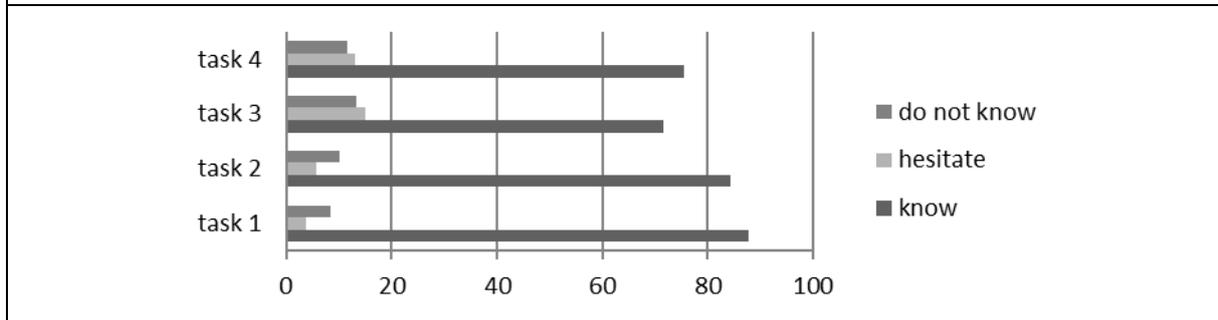
In order to overcome the difficulty imposed by the transition from the abstract to the concrete the students under the guidance of the teacher have to become acquainted with the situation that has been presented through the model, to choose the storyline of the task. An important moment of the front work with the students is the way in which the teacher will construct the discussion with them. The following task can be given in addition: *What other questions can you ask to the text task?*

Results

The experimental work was performed with students from Grades 1-4 from the Second Elementary School “Petko Rachov Slaveykov”, in the town of Stara Zagora during the period 2018-2019. For the purposes of the empiric study two tests were used: one of the tests was used to assess the entry diagnostic and the second one- after applying the newly developed methodology system of work - was used to assess the exit diagnostic of the knowledge, the skills and the competencies of the Grade 4 students from the competency cluster “Modelling”.

The objectiveness, the validity and the reliability of the tests were studied as well as the level of difficulty and the separating strength of the tasks included in them.

Figure 4: Exit diagnostic of the knowledge, the skills and the competences of the students to solve text task



Source: Author

Analysis of the results of the experimental work was done. The exit diagnostic showed that the percentage of the students from Grade 4 who fail to solve text tasks with direct and indirect use of relations decreased from 31.2% to 8.5%. 3.7% of the students hesitate how to solve the tasks and 87.8% of them work correctly. The percentage of the students who cannot describe a situation from the real world with a mathematical model decreased from 45.3% to 10.1%. 5.6% of the students hesitate how to create the model and 84.3% work correctly. The percentage of the students who correctly composed text tasks increased from 29.5% to 71.6%. The difference in the results was proved to be statistically significant.

Conclusion

Based on the results from the study the following conclusions can be made: due to the applied methodology system of work for solving text tasks the level of knowledge, skills and competencies from the competency cluster “Modelling” of the students increased. The creative work with text tasks facilitated the development of students thinking.

The creative level of the mathematical activity of the students depends on the activity of the teacher, of the strategies, the technologies, the approaches and the methods, of their explanations and questions, of the text tasks which they choose for solving during mathematics classes in primary school.

The developing character of the organization of collective and individual search and the creation of hypothesis by the students over the process of tasks solving stimulates development of their thinking because the students have to perform a transfer of mathematical knowledge, skills, competencies and competencies and not only reproduce the knowledge already learned and to solve tasks with reproductive character.

The simultaneous use of observation, experiment, analysis, abstracting, synthesis, comparison, summarizing, concretization and specialization by the students in different moments of their cognitive activity and also the purposeful application of these tools by the teacher as part of their methodology system of work during the education of mathematics for Grades 1-4 enforce the creative element in the educational activity of the students for solving text tasks.

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